

CLAIMS

What is claimed is:

1. An apparatus for cleaning a surface within a vessel having a vessel wall separating a vessel exterior from a vessel interior and having a wall aperture, the apparatus comprising:
 - an elongate conduit having an upstream first end and a downstream second end and positioned to direct a shock wave from the second end into the vessel interior; and
 - a source of fuel and oxidizer coupled to the conduit to deliver the fuel and oxidizer to the conduit; and
 - an initiator,wherein:
 - the conduit comprises a first portion and a second portion downstream of the first portion;
 - the first portion has a first characteristic cross-sectional area and the second portion has a second characteristic cross-sectional area, greater than the first characteristic cross-sectional area;
 - the initiator is positioned to initiate a deflagration in the first portion of the fuel and oxidizer; and
 - the conduit first and second portions are positioned to permit a deflagration-to-detonation transition from said deflagration to produce said shock wave.
2. The apparatus of claim 1 wherein the source comprises:
 - a first fuel source of a first fuel;
 - a first oxidizer source of a first oxidizer;
 - a second fuel source of a second fuel; and
 - a second oxidizer source of a second oxidizer.
3. The apparatus of claim 2 wherein:
 - the second fuel and oxidizer sources are coupled to the conduit downstream of where the first fuel and oxidizer sources are coupled.
4. The apparatus of claim 1 wherein:
 - the second portion comprises a plurality of conduit sections secured end-to end and being of essentially constant characteristic diameter; and

the first portion includes an upstream portion of essentially constant characteristic diameter and a downstream portion having an essentially downstream increasing diameter.

5. The apparatus of claim 1 wherein:

the first portion comprises an internal surface area enhancement.

6. The apparatus of claim 1 wherein:

the second portion comprises an internal surface area enhancement.

7. The apparatus of claim 1 wherein:

the first portion of the fuel and oxidizer is a minor portion and is more detonable than a major second portion of the fuel and oxidizer.

8. An apparatus for cleaning a surface within a vessel having a vessel wall separating a vessel exterior from a vessel interior and having a wall aperture, the apparatus comprising:

an elongate conduit having an upstream first and a downstream second end and positioned to direct a shock wave from the second end into the vessel interior; and

means for introducing first and second fuel/oxidizer mixtures to the conduit and initiating a deflagration of the first mixture so as to produce a deflagration-to-detonation transition from said deflagration and detonate said second mixture to produce said shock wave.

9. The apparatus of claim 8 wherein:

the oxidizer of the first mixture is more oxygen-rich than the oxidizer of the second mixture.

10. The apparatus of claim 8 wherein:

the second fuel/oxidizer mixture is different from the first fuel/oxidizer mixture in chemistry or proportion.

11. The apparatus of claim 8 wherein the means comprises:

a plurality of changes in conduit internal transverse cross-sectional area.

12. A method for cleaning a surface within a vessel, the vessel having a wall with an

aperture therein, the method comprising:

providing a first fuel/oxidizer mixture in a first conduit portion;

providing a second fuel/oxidizer mixture, different from the first in chemistry or proportion in a second conduit portion; and

initiating a reaction of the first fuel/oxidizer mixture so as to, in turn, cause a detonation of the second fuel/oxidizer mixture so as to cause a shock wave to impinge upon the surface.

13. The method of claim 12 wherein:

the reaction of the first fuel/oxidizer mixture comprises a deflagration-to-detonation transition.

14. The method of claim 12 wherein:

the second mixture is less detonable than the first mixture.

15. The method of claim 12 wherein:

the oxidizer of the second mixture is less oxygen-rich than the oxidizer of the first mixture.

16. The method of claim 12 wherein:

the first fuel/oxidizer mixture is introduced to the first conduit portion as separate fuel and oxidizer components; and

the second fuel/oxidizer mixture is introduced premixed to the second conduit portion.

17. The method of claim 12 wherein:

the first fuel/oxidizer mixture is introduced premixed to the first conduit portion; and

the second fuel/oxidizer mixture is introduced premixed to the second conduit portion.

18. The method of claim 12 further comprising:

purging the conduit with a purge gas.

19. The method of claim 12 wherein:

the first conduit portion has a characteristic cross-sectional area less than a characteristic cross-sectional area of the second conduit portion.

20. The method of claim 12 wherein:

a major portion of said first fuel/oxidizer mixture is provided before a major portion of said second fuel/oxidizer mixture is provided.